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# THE USE OF ARTIFICIAL INTELLIGENCE IN THE EDUCATIONAL CONTEXT: WHAT IS MISSING?

*O uso da inteligência artificial no contexto educacional: o que falta?*

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**ABSTRACT**

This essay aims to discuss the importance of the use of artificial intelligence (AI) in the education area, seeking to establish elements of dialogue between a tool, AI, and an important field of research, education. In the first place, it is important to distinguish between technological innovation as a broad concept and innovation in the educational area. These two concepts have been mixed in many debates, since the expansion of distance learning education model, caused by covid-19 world health crisis. After that, the concept of AI is introduced, which modernly began its process of global dissemination via generative languages, presenting complexities not yet fully understood in the educational context. Finally, the paper suggests that there may be a lack of technical competence in the educational area to deal with fast moving changes, proposed initially by distance learning strategy. Also, especially important, and urgent, there might be a creation of some regulation for the use of AI in the educational area; however, it depends basically on political will and political system to its implementation. If this situation does not happen, the outcome may be an increase of precariousness of the educational services, due to an absence of understanding, from part of some education market main actors, of their intrinsic competences of education, exposing latent problems of inability to provide minimum learning guarantees to the students, with a good and acceptable level of teaching.

**Keywords**: Higher Education, Artificial Intelligence, Regulation, Education Management.

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# O USO DA INTELIGÊNCIA ARTIFICIAL NO CONTEXTO EDUCACIONAL: O QUE FALTA?

*The use of artificial intelligence in the educational context: what is missing?*

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## RESUMO

Este ensaio tem como objetivo discutir a importância do uso da inteligência artificial (IA) na área educacional, buscando estabelecer elementos de diálogo entre uma ferramenta como a IA e um campo importante como a educação. Em primeiro lugar, é importante distinguir entre inovação tecnológica como conceito amplo e inovação na área educacional. Esses dois conceitos têm se misturado em muitos debates desde o aumento do modelo de educação a distância, causado pela crise sanitária mundial da covid-19. Em seguida, é apresentado o conceito de IA, que modernamente iniciou seu processo de disseminação global via linguagens generativas, apresentando complexidades ainda não totalmente compreendidas no contexto educacional. Por fim, o artigo sugere que pode haver falta de competência técnica na área educacional para lidar com as rápidas mudanças propostas inicialmente pela estratégia de ensino a distância. Além disso, especialmente importante e urgente, poderá haver o estabelecimento de alguma regulamentação para o uso de IA na área educacional; no entanto, depende basicamente da vontade política e do sistema político para a sua implementação. Caso contrário, o resultado poderá ser um aumento da precariedade dos serviços educacionais, devido à ausência de compreensão por parte de alguns atores de suas competências intrínsecas à educação, expondo problemas latentes de incapacidade de fornecer garantias mínimas de aprendizagem aos alunos de um bom e nível aceitável de ensino.
**Palavras-chave:** Ensino Superior, Inteligência Artificial, Regulação, Gestão Educacional.

## INTRODUCTION

Since the advent of industrial society, workers have been progressively recognized as a preferred resource for producing wealth and promoting socioeconomic development. The tool for this transformation has been, with no doubt: education. Education has been argued as an instrument capable of organizing society, since the transition from individuals to citizens, exponentiating the family function and modernly appropriated by consumer society, as a product to be sold.

Like other economic segments, it became dynamic with the advent of information technology, which gave it new scope and more complexity. Thus, it is important to differentiate specific application of technologies, such as the artificial intelligence (AI), from the massive dissemination of distance education courses, without any specific regulation to keep the quality of the teaching and learning processes.

However, education sector, recently affected by the world health crisis of COVID19, was forced to adopt digitalization compulsorily. By the advent of generative languages, it offered possibilities for an enormous transformative effect, that never had been considered before.

In regard of all these aspects, this paper aims to understand how the education sector faces the challenge to introduce these innovative technologies, particularly the AI, into the local education sector. Thus, this essay came up with the following question: Whether the existence and the use of AI is unquestionable, what is missing in the education context, regarding the use of new technologies such as AI?

In an attempt to answer the research question, this essay investigates the significance of integrating artificial intelligence (AI) into education, emphasizing the need for a nuanced understanding of technological innovation within the educational sector. The differentiation between general technological innovation and its specific application in education is highlighted, particularly considering the COVID-19-induced surge in distance learning. The essay introduces the concept of AI, emphasizing its global dissemination through generative languages and the resultant complexities within the educational landscape. A central concern is raised regarding the potential lack of technical expertise in education to address the rapid changes prompted by distance learning strategies. The essay also underscores the urgency of formulating regulatory frameworks governing AI use in education, contingent upon political will and effective implementation of systems.

To achieve the aim of this discussion, a bibliometric survey was undertaken, incorporating thirty-seven references to underpin the argumentation. The bibliometric technique employed for the selection of works in this study involved several systematic stages. Initially, a clear identification of the study's scope and objectives was conducted, outlining the areas of interest related to the research question. Subsequently, the definition of search criteria took place, encompassing key terms and relevant concepts for the study. Following this, an extensive search was conducted across academic databases, scientific journals, and other pertinent sources, employing the pre-established criteria. The collection of bibliometric data ensued, involving the cataloguing and analysis of information such as authorship, publication year, journal source, and citations. Initial screening was executed based on inclusion and exclusion criteria, aiming to select works that met the specific requirements of the investigation. Subsequently, a qualitative evaluation of the content of the selected works was undertaken to figure out their relevance and contribution to the pertinence of this research. This rigorous methodological process in the application of bibliometrics aimed to ensure a comprehensive and well-founded approach in the selection of works for the study.

This paper is divided into five sections: State of the art discussion about the interaction between AI and education, innovation in the context of educational area, artificial intelligence in the educational context, methodology and conclusion.

## 1 THE STATE-OF-THE-ART DISCUSSION ABOUT THE INTERACTION BETWEEN AI AND EDUCATION

In various contexts, we notice a discrepancy between high-level artificial intelligence (AI) principles and their practical implementation, suggesting impact assessments as a solution. Schiff, Rakova, Ayeshi, Fanti, and Lennon (2020) highlight that, although many companies adopt AI principles, they face difficulties in translating

them into actionable practices due to complexities and disciplinary divisions. Thus, according to the authors, the use of an impact assessment framework, especially the IEEE 7010 standard focused on AI's impact on human well-being, can serve as a comprehensive approach to bridge this gap. Broad, operationalizable, flexible, iterative, guided, and participatory frameworks can help organizations better understand and mitigate the diverse impacts of AI, promoting responsible practices.

The growing presence of AI applications in higher education requires educators to adapt to prepare students for a technologically advanced future, assure Razia, Awwad, and Taqi (2023). Educational institutions must, therefore, adopt visionary strategies to balance the use and value of AI, aiming to enhance teaching and learning; focusing on the continuous development of AI technologies, promoting educational quality, while effectively managing knowledge and providing adequate technological resources, avoiding obsolete systems to overcome challenges and inefficiencies.

Despite the first promises of AI in education three decades ago, Chaudhry and Kazim (2022) maintain that significant advances are still needed to see large-scale disruption in education, including basic infrastructure. The focus should not be on promoting AI, but on supporting education, with the assessment of AI's impact on education done through learning outcomes. Reducing teachers' workload, for example, is more impactful if it allows teachers to focus more on student learning, leading to better learning outcomes. The future of this relationship, especially with reinforcement learning techniques, presents exciting possibilities for education, keeping learners and teachers at the center of AI development.

In the application of artificial intelligence (AI) technologies in STEM (a.k.a. science, technology, engineering, and math) education, Xu and Ouyang (2022) highlight the integration of various AI techniques in this complex educational system, with an emphasis on the need for advances for effective implementation of AI that effectively supports teaching and learning. Their conclusions point to the significant potential of AI technology to enrich education, especially in these disciplines, suggesting educational, technological, and theoretical implications for the application of AI techniques, as well as encouraging future investigations into the integration of technology and the educational system.

From this international debate about the interaction between artificial intelligence and the educational context, Crompton and Burke (2023) demonstrated that there has been a significant increase in publications, indicating new research trends. The first and most clear is a geographical shift in the leadership of publications, with China surpassing the US, and a diversification of researchers' affiliations, especially in the field of education. In these dynamic, undergraduate students have become the main focus, and language learning emerges as an increasingly common domain. Five main uses of AI in education were found: assessment, prediction, AI assistant, intelligent tutoring system, and student learning management. Let us see, now, how this state-of-the-art discussion in Brazil behaves.

The integration of artificial intelligence (AI) in education, highlighting its use in financial, professional, and personal activities, and its potential in large educational companies is one of the standout studies by Silveira and Vieira (2019). It emphasizes the need for political, pedagogical, ethical, and social alternatives to optimize the use of AI, aiming to facilitate access to knowledge and promote distance education. The researchers highlight the importance of overcoming physical and institutional barriers, allowing for equitable distribution of knowledge through AI platforms.

Parreira, Lehmann and Oliveira (2021), exploring teachers' perceptions and evaluations of the impact of artificial intelligence (AI) technologies in education, conclude that teachers recognize the transformative potential of AI in educational practices and in teaching employment, but also express concerns about the challenges and the need for adaptation to new pedagogical demands. They suggest the importance of developing digital and methodological skills in teachers, as well as strategies to effectively integrate AI into teaching, ensuring a balanced approach that values both human skills and technological advantages.

Regarding the discussion on the impacts and challenges of the use of Artificial Intelligence (AI) in education, Figueiredo, Lopes, Validorio and Mussio (2023) highlighted how AI can personalize learning, creating autonomous educational environments and perfecting student assessment. They also emphasized the importance of considering the ethical, cognitive, and emotional implications, especially in the use of AI by children. Their study

concluded the need for a balanced and responsible approach to integrating AI in education, aiming to maximize its beneficial potential, while mitigating potential risks.

Finally, in an analysis of one of the most successful tools in the use of artificial intelligence, ChatGPT, Rodrigues and Rodrigues (2023) reinforced that this technology is not neutral, insisting on the importance of promoting ethical use of AI to mitigate long-term risks. For the researchers, AI does not ensure objectivity or neutrality simply by being machine-processed, emphasizing the need for reflective, conscious, and critical use; highlighting the urgency to confront technological acceleration without clear goals and to deeply discuss the ethical and social implications of the advancement of generative AI in the educational context.

In the following sections, considering here the dynamics of the relationship between artificial intelligence and the educational context, we present a deepening of this discussion, consisting of a call to the preponderance of understanding education as technology and deepening of the implications of artificial intelligence in the teaching-learning process.

## 2 INNOVATIONS IN THE CONTEXT OF EDUCATIONAL AREA

One of the founding elements to be considered for innovation in the educational segment is concerned with the understanding of its relationship with the labor market, especially with regards to higher education system. Higher education is the result of the social effort to insert regular citizen into the economically active population. Since the transition from handmade work to industrial work, theorists have sought to understand and describe this interaction.

Adam Smith, in his book “The wealth of nations” (2016), describes, in a visit to a pin plant, how craftsmen were reorganizing themselves in a more productive way, relegating the model in which individuals were occupied to produce pins to another system where the division of labor was carried out through specialized actions by each one.

This transformation was understood by Marx (2004) as a change in the model of worker's surplus value appropriation, perceived in the feudal regime until the new sphere of industrial work come. His conclusions were later operationalized by Taylor (1961), when Ford created his assembly line (Wilson, 2014), allowing, with the delivery of the work to the worker, to increase the pace of his production in relation to its direct costs.

However, it was Theodore Schultz (1971), with the Human Capital Theory, who argued that the main resource to produce wealth, in the contemporary capitalist economy, is the qualified worker (Osiobe, 2019). This perspective proved that the part of income offered by qualification grows proportionally to its economic contribution, which made families and the state significantly increase the portion of income committed to investments in education (Lee and Desjardin, 2019). The direct result of this process has been the increasing shift in the employment curve, from the industrial sector towards the services sector, notably those in charge for the processing of information (Hupes, 2012), which demands more intellectual skills.

This new worker, recognized as a symbolic analyst, for maintaining his main income related to the capture, transformation, and dissemination of information, is the one who mostly uses mobile devices, creating digital records and staying permanently connected to the internet, interacting in different ways ostensibly through social networks, getting even to the point of feeling disconnected from society when not online.

As shown by Stewart (2010), this worker is also responsible for contributing, through his intellectual capital, with a representative part of an organization's brand value. His production of wealth far exceeds the physical and financial capital as part of the value of companies, as well as he contributes with: (a) structural capital, represented by organizational capabilities, mechanisms for dissemination of knowledge, strategy, vision and culture, in addition to the company's management structure; (b) relationship capital, understood as loyalty and interaction with customers, distribution and marketing channels and strategic alliances; and finally, the already recognized (c) human capital, indicated by individual competences and potential for innovation, work group interaction, and for the values he promotes.

All this development has been potentialized by the interaction between education and technology (Goldin and Katz, 2009), in the search for innovative contexts to empower workers.

This race for innovation presents gaps that promotes social stress and prosperity, since the universalization of education during the industrial revolution. So, we are witnessing, in the current digital revolution, a new scenario for classrooms which must use technological resources such as: interactive videos, learning strategies adaptable to the pace of students, customized content, and immersive virtual environments.

Since Education is one of the most virtualizable assets of economy, it produces, according to Distrito (2019), a Brazilian education platform, 434 Edtechs (a.k.a., Education Services Startups), in areas ranging from Student Teaching Funding, Education Support Platforms, New Forms of Teaching Methodologies, New Tools for Education Institutions Management etc.

The health emergency caused by COVID-19 has accelerated the process of technological innovation in all sectors, pushing organizations into the digital world and streamlining projects that were already underway. This dynamic was not different in the educational economy.

Nowadays, platforms such as EDX (2023), founded by Harvard University and the Massachusetts Institute of Technology, bring together more than 150 schools, non-profit organizations, and corporations worldwide that offer or plan to offer online courses. According to EDX, on July 20, 2020, there were at least 3,000 courses available to thirty-three million enrolled students; many of the courses were free, with a fee only if the student needed some kind of certification.

In Brazil, a single enterprise, Alura (2023), specialized in technology education, has more than 50,000 students on its on-demand learning platform, with 26% of them accessing classes via mobile devices. It offers 1,313 courses, with constant updates and improvements, in a mix of educational products that is much broader than any university that offers formal education in the country.

The education market is structured through the action of educational organizations, mediating the relationship between consumers and suppliers of information assets, that been the teachers. In this new context of educational innovation, Silveira and Barros (2021) showed that, of the 97.18% of skills implemented in the classroom by teachers, no less than 77.29%, according to specialists, could be absorbed by artificial intelligence tools; more than half of them in a short period time (1-3 years) and the other half in medium term (3-5 years).

The emergence of this impact has been widely socially discussed after the advent of generative languages such as ChatGPT, due to its potential to reach several areas of remunerated human activities. However, this great advance might follow the path of other technologies (calculating machines, computers etc.), being initially considered a differentiation for a professional in the labor market, and then starting to be perceived as a desirable competence, until it becomes mandatory.

In fact, this interaction between education and the labor market has become chronic since the advent of higher distance education. Like any innovation process, a context of marginal evolution was expected, where good practices of balanced investments between people, processes and technological infrastructure would be the keynote. However, at least in the Brazilian context, the education sector opening for privatization, due to the 1996's Guidelines and Bases of National Education Law, meant that the distance modality, regulated a few years later, was used as a tool of competitiveness by the sector economic agents, with most of the emphasis on cost reduction.

The process became critical, to the point of changing the structure of players in the market in the following years, precisely because of the regulation inability in extracting all the consequences of the distinction between technological and educational innovation.

The massive investment established in this scenario has little benefit from what educational technology effectively deals with, exponentiating the amateurism already characteristic of higher education, which relies on professional workers that became teachers as a side job instead of professional teachers, an academic management lacking administrators with pedagogical training, and a structure incapable of focusing on what matters in the educational service, the effectiveness of learning.

In Brazil, with a regulatory model that orbits in a debate of discourses that are much more ideological than technical, the educational crisis has reached a critical point with the mandatory use of distance learning, due to the Covid health crisis of 2019.

What we can conclude, based on these elements, is that the educational sector misunderstands this technological gap, where it is strongly recommended that it dominates educational innovations, before considering investing in information technology innovations. The educational competence is directly associated with at least

three domains: (a) educative object design based on competences, which are the results of what a professional can produce using a set of skills, from contents mobilized for these goals; (b) curriculum engineering, which is responsible for ensuring that the complexity of knowledge is contributing for the perspectives of the career building, cognitively based on real-world problems; (c) guaranteed learning, capable of taking advantage of the interactivity potential of educational modalities, selecting educative processes with different teaching strategies, personalized assessments and adequate emphases to guarantee good learning results.

## 3 ARTIFICIAL INTELLIGENCE IN THE EDUCATIONAL CONTEXT

The literature shows several types of innovation. The Oslo Manual (Organization for Economic Co-operation and Development, 2005), an international paradigm adopted in Brazil, which set up the main theoretical frameworks for research in the field of innovation, shows four types of innovation: product, process, organizational and marketing.

Although there have been particularly significant changes in the organizational aspect, especially with the emergence of large global education networks, it is a certain technological product innovation that today challenges the understanding of educators: artificial intelligence (AI). AI is a technology that enables machines such as computers to act and think intelligently like human beings. This kind of technology has provoked polarized reactions; on one hand, the irrational fear of a dystopian world, in which humans would be servants of conscious machines, endangering civilization and the human species; on the other, the belief that AI brings such benefits and that the risks are acceptable.

We intend to move very much away from these two perceptions of AI, seeking to identify its risks and benefits in a more balanced way. Our perspective on this topic involves a few key points.

First, from everything we can see in the world today, it is unavoidable not to assimilate AI in every technology that has proved to be productively efficient.

The problem here is that technologies become part of society, in general, through their commercial and, especially, industrial, and military insertion. Introducing technology into a production or commercial process, with the technology available, involves a business decision. But understanding and regulating the use of technology involves much more complex and slower processes.

Understanding the implications of a certain technology that did not exist before depends on time, analysis, and experimentation (Nadimpalli, 2017). Like every technology that is not directly derived from an already proven theory, as most new disruptive technologies are not, its improvement is by trial and error. Knowing how technology works and assessing the consequences of its applications allow society to develop criteria and rules for its use.

A critical condition for a socially responsible implementation of an AI is facing the challenge of understanding and regulating its processes and consequences, including how AI may arrive at certain results: what criteria were considered, which alternatives were discarded (and why), and how decisions are weighted.

A second consideration, in addition to the time needed for understanding AI in terms of processes, is the time for regulation, which faces a delay, since it depends on political processes, including complex discussions, where the regulation of its use will be subject to negotiation between multiple and different interests.

Let us remind Solow (1987), who argued, in the early 1990s, about the discrepancy between the existence of computers in companies and the level of productivity in the economy. According to him, “computers are seen everywhere, except in productivity statistics”; this is the Solow Paradox.

What he was saying was that, at that moment, computers were being acquired and used on a large scale, but the expected increase in productivity was not being perceived in economy. His article was harshly questioned, at first, when theoretical gaps and fragility in the data used by Solow were alleged.

These questionings were dispelled by others research that supported Solow's conclusions. Then, an important series of works pointed out exactly to the need for some time to better known the implications of technology adopted at various levels in business, as well as its efficient assimilation: in companies themselves, in courses and training of workers and managers, in redesign of radical changes in work processes and in the organizational structure itself; in society, through the adoption of general regulatory measures and, especially, those that would redefine work relations in this new context (Castells, 1999).

The introduction of AI undoubtedly follows this same path. We will deal with technological innovation without the establishment of regulation. For simpler uses, the problems are relatively small, but for any specialized use, it will probably bring us to Solow and his paradox.

A third important aspect to understand AI is its concept and categorization. AI might be defined as a sub-area of computer science, which aims to create computer systems or machines that can perform tasks that normally require human intelligence. This includes, but it is not limited to, things like learning and adapting to new situations, understanding natural language, recognizing patterns, solving complex problems, and interacting with the environment. AI is often categorized into two main forms (Kaufman, 2022): (a) Weak (or narrow) and (b) Strong (or general) AI.

Weak AI is designed to perform a specific task, such as speech recognition or product recommendations. It runs under a limited set of constraints and does not have the ability to understand or learn outside these defined constraints. This type of AI is a rapidly developing field and has many applications, from online recommendation systems and virtual assistants to self-driving cars and health data analysis. Strong AI, in contrast, is still largely theoretical and has not been considered in practice (Buiten, 2019). It refers to systems that could understand, learn, and apply knowledge, in addition to perform specific capabilities and tasks for which they were trained. In thesis, a strong AI could perform any intellectual task a human being can do.

Then, it is important to understand that the AI technology, which is being made available, is the weak one. Some media channels and others communication sources not well informed seem to work as if we were facing a world driven by a robot designed and controlled by AI, as in Isaac Asimov's Fictional Robots (2015).

On the other hand, Pagels (1988), exploring the intersection of physics, science computer and philosophy, refers to AI adopting a cautious and realistic approach. He argued that, even though computers can process information much faster than human beings and can "learn" in a limited sense through machine learning algorithms, they are fundamentally limited.

He emphasizes that the intelligence and consciousness are an extraordinarily complex phenomena that cannot be fully captured or reproduced by computer systems, no matter how advanced they are. Nicolelis (2017) suggests that this inconsistency is due to the essence rationale, the first one intrinsically analogue, the other digitally structured. Pagels (1988) also recognizes the potential of computers and AI to transform society and support scientific advances, but, at the same time, he warns us against overestimating their capabilities and underestimating the complexity of human intelligence and consciousness.

There are numerous important aspects to examine about AI, but let us focus on issues involving AI in education only. Implementing Artificial Intelligence (AI) in education brings a set of potential risks that include:

(a) The Risk of Biases and Inequalities. AI algorithms are trained on existing datasets and may inadvertently, reinforce existing biases and inequalities. For example, if an AI program is trained on a dataset that holds racial, gender, or socioeconomic biases, it can reinforce those biases, when making recommendations or assessments.

(b) The Risk of Data Privacy: AI in education relies on collecting and analyzing massive amounts of data about students, including their activities, performance, behaviors, and even personal characteristics. This raises significant concerns about data privacy and the potential for misuse of these data.

(c) The Risk of Limited Social Interaction: with the adoption of AI to customize and to automate learning processes, there is a risk that students may miss out some valuable opportunities for social interaction and collaboration, which are key parts of the learning process.

(d) The Risk of Technology Dependency: over confidence on AI in education can lead to a deficit in fundamental human skills, such as critical thinking, complex problem solving and creativity models. Furthermore, if AI systems fail or are compromised, education can be significantly disrupted.

(e) The Risk of Inequality of Access: Not all students have equal access to technology. The reliance on AI in education can inadvertently widen the digital divide and create inequalities in access to education of quality.

(f) The Risk of Inaccurate Assessment: AI systems may not be able to accurately assess all student competencies, particularly those involving creativity, people skills, and complex critical thinking. There is also a risk of AI systems misinterpreting student responses.

(g) Finally, The Risk of Non-Responsibility: In the case of errors or harm caused using AI in education, it can be difficult to figure out accountability, especially if the AI is making autonomous decisions.

Each of these risks can be mitigated by preventive and control measures, even though, almost often they go beyond the level of the teacher and the classroom (online or not). Also, it depends on state regulatory actions, such as regulations for data privacy, attribution of responsibilities in the AI processes, investments in the national information technology infrastructure, policies that mitigate the impact of automation, and regulation of educational organizations, especially in their economic dynamics and pedagogical planning. Such measures are necessary to avoid the risk of limited interaction between students and teachers, which - from the point of view of the quality of education – is the main problem that has been detected in the use of this technology in education, in the context of the current distance learning format, and whose regulation could expand radically.

There is, in fact, a potential conflict between organizational interests in obtaining results from their investments, which prioritize the broad use of technology as a profitability factor, and the need to ensure broad human interaction in training courses (Schiff, Rakova, Ayeshi, Fanti, Lennon, 2020). It is not an impassable conflict, since the use of technology increases productivity, and the use of part of this increase in productivity would allow the maintenance of adequate interaction. The central issue here is that the resolution of this conflict depends on adequate regulation, which does not seem to occur in the countries today.

The central question in the models of technology use in education, an issue present in a more disruptive way in the use of AI, is the need for a balance between automation and interaction (Fialho, Barros, Rangel, 2019). Automating routine and repetitive learning tasks without limiting the presence and interaction with educators will improve reflective production of knowledge, emotional support, stimulation of creativity, encouragement of active participation and development of social and emotional skills. In this sense, teachers' participation in the development and implementation of AI solutions is essential to ensure that the tools are adapted to the real needs of the classroom, following the best pedagogical principles.

This participation is even more important when is considered that, until 2014, the most significant machine learning models were launched by academia itself. But, since then, the industry has taken over this process. In 2022, there were thirty-two significant machine learning models produced by private companies, compared to only three produced by academia (Meira, Neves, Calegario, Belfort and Garcia, 2023). Building next-generation AI systems requires ever-increasing amounts of data, computation, and financial investments, resources that industry players inherently own in greater amounts, compared to non-profit organizations and academia.

Given the risks, AI systems, such as ChatGPT, can provide suggestions for the following uses in learning processes: (a) Personalized Learning: AI can customize teaching strategies to meet individual student needs. For example, it can design tailor learning materials based on student performance, providing more activities where the student is struggling with and advance faster in areas where he has more proficiency; (b) Intelligent Tutorial Systems: they can provide real-time feedback to students, helping to explain complex concepts, answering questions, and even posing personalized problems and exercises; (c) Automated Assessment Systems: AI can be used to create automatic assessments of tasks and exams, providing quick and customized feedback to students. This not only saves teachers' time, but also allows students to learn from their mistakes more quickly; (d) Virtual Assistants: AI based virtual assistants can help answer students' questions, schedule assignments, and remind them of upcoming deadlines. In addition, these assistants can facilitate communication and collaboration between students and teachers; (e) Early Detection of Learning Difficulties: AI systems can analyze students' learning and performance patterns to identify in advance those who may be at risk of failing. This allows teachers and counsellors to step in earlier, providing added support; (f) Learning of Different Languages: AI programs can help students learn new languages by providing translations, pronunciation, practice, and real time feedback.

Moreover, one of the greatest issues in education, which is considered to be one of the areas that shall be mostly affected by AI in the coming years, is the relationship between AI and the job market. The fact is that existing studies on this relationship have a high degree of uncertainty: 80% of American workers will have 10% of their tasks affected, and almost 20% will have 50% of their tasks affected; 1/5 of tasks in the US and EU will be automated by AI (Eloundou, Manning, Mishki and Rock, 2023).

There are already examples of how technology differently affects jobs in many sectors: in 1986, there were 900,000 bank workers in Brazil; in 2017, 327,000 (Albuquerque, Saavedra, Morais, Alves and Peng, 2019). On the other hand, the World Economic Forum predicted in 2018 that, although automation would displace seventy-five

million jobs by 2022, it would create 133 million new jobs, resulting in a net gain of 58 million new jobs (World Economic Forum, 2020).

This number was not confirmed or denied, but it seems that AI tends to have a negative effect on wage income, by increasing competition for the remaining jobs and inequality because unemployment will affect mainly low skill activities. In the European Union, the richest countries, which use technology the most, are the ones with the lowest long term unemployment rates (LTUR) in the world. The general trend of the LTUR is downward, according to data from Eurostat (2023); in 2012 the average rate was 6%, today, says EU statistics office, is around 2%.

## 4 METHODOLOGY

The present study conducted bibliographical research in areas such as artificial intelligence, innovation, and education, allowing the construction of a theoretical foundation. To achieve the goals of this study, a bibliometric survey was undertaken involving several sources such as books, dissertations presented in postgraduate programs, articles in national and international journals, in addition to consultations on websites.

The bibliometric survey involved several steps: a clear identification of the study's scope and goals was conducted, outlining the areas of interest related to the research question. Subsequently, the definition of search criteria took place, considering key terms and relevant concepts for the study.

Following this, an extensive search was conducted across academic databases, scientific journals, and other pertinent sources, employing the pre-established criteria.

The collection of bibliometric data was undertaken, involving the catalogue and analysis of information such as authorship, publication year, journal source, and citations. Initial screening was executed based on inclusion and exclusion criteria, aiming to select works that met the specific requirements of the investigation.

Subsequently, a qualitative evaluation of the content of the selected works was undertaken to decide their relevance and contribution to the pertinent research. This methodological process aimed to ensure a comprehensive and well-founded approach in the selection of works for the study.

## CONCLUSION

The main discussion of this essay points out to an essential need for the future of education: the regulation of AI and its use, considering a deep understanding of education as a technology that should be mastered, before considering the implementation of such an important breakthrough as artificial intelligence. Also, it has pointed out that this subject depends, fundamentally, on the political will and the political system to implement it. This is exactly the most critical point of the current position of many countries, such as Brazil. The debate is full of ethical and ideological distortions, with predominance of various groups in the political arena with different thoughts.

At the same time, it is necessary to recognize that whether democratic institutions remain solid and with broad support from society, this context gives confidence to move forward in some kind of regulation for AI. Even if there is a long and complex way to go, there are reasons to hope for better days for the education system and for the use of AI.

Hopefully, new improvements in the movement of regulation of the use of AI in the education field may come up to contribute to the debate of better educational strategies, focusing on the future of the students, economy, and society. If not, there is a huge risk of the outcome be an increase of precariousness of educational services, due to the lack of use of new technologies and the absence of understanding of education intrinsic competences by teaching organizations, exposing latent problems of inability to provide minimum learning guarantees to the students with a good and acceptable level of teaching.

As any computer science student knows, the lack of balance in an information system implementation budget, concerning technology, people, and process, may produce the acceleration of management problems. As a parallel, the use of technology, without the proper preservation of educational principles, could lead to the creation of citizens that are unable to live in a society with human values, that can only be taught properly by human beings.

The central argument, underpinning the discussion in this essay, underscores the critical importance of a profound comprehension of education as a technology that must be mastered, before its integration with a transformative force, such as artificial intelligence (AI). This comprehension considers the broader issue of innovation in education, emphasizing the necessity to accommodate technological advancements within the context of established educational norms. The exploration of AI's integration in education and the subsequent call for regulation are intricately linked to the broader discourse on innovation. This essay contends that effective regulation of AI in education is imperative for the future of Brazilian education, and its successful implementation is contingent upon political will and systemic support. The intricate relationship between these elements reflects the multifaceted nature of innovation, not only in terms of technological advancements, but also in the regulatory frameworks governing their application. In the Brazilian context, we also highlight the challenges arising from political dynamics and ethical considerations, underscoring the need for a more balanced and transparent approach to innovation within the educational sphere.

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